CLAIMS:

What is claimed is:

1. Apparatus for controlling the placement of a polymer composition into a porous web having a plurality of structural elements with interstitial spaces therebetween comprising:
means for applying tension to the porous web;
means for applying a curable, shear-thinnable, polymer composition onto a surface of the tensioned web; and
means for shear thinning the polymer composition to substantially reduce its viscosity and selectively placing it into the tensioned web, leaving at least some of the interstitial spaces open.

2. Apparatus as set in forth in Claim 1 wherein said polymer composition is selectively placed to encapsulate at least some of the structural elements of said web.

3. Apparatus as set forth in Claim 1 wherein said polymer composition is selectively placed as an internal layer within said web positioned in a region extending through the web in a direction generally spaced from at least one major surface of said web.

4. Apparatus as set forth in Claim 1 wherein said polymer composition is selectively placed to encapsulate at least some of the structural elements of said web and to form an internal layer within said web in a region extending through the web in a direction generally spaced from at least one major surface of said web.

5. Apparatus as set forth in Claim 1 wherein the means for shear thinning and placing comprises a blade urged against the surface of the tensioned web downstream of the position where the polymer composition is applied to the web.

6. Apparatus as set forth in Claim 1 wherein the means for shear thinning and placing comprises two or more blades spaced apart from one another and urged against the surface of the tensioned web.

7. Apparatus as set forth in Claim 6, including means for controlling the spacing between said blades.

8. Apparatus as set forth in Claim 5 wherein said blade is positioned perpendicularly to said moving web.

9. Apparatus as set forth in Claim 5, including means for varying the angle of said blade relative to said web.

10. Apparatus as set forth in Claim 5, including means for controlling the force of said blade against said web.

11. Apparatus as set forth in Claim 5 including means for advancing the web past said blade.

12. Apparatus as set forth in Claim 11, including means for varying the exit angle of the moving web relative to said blade.

13. Apparatus as set forth in Claim 11 including means for varying the entrance angle of the moving web relative to said blade.

14. Apparatus as set forth in Claim 11 including means for varying both the entrance angle and the exit angle of said moving web relative to said blade.

15. Apparatus as set forth in Claim 6, including means for advancing the web past said blades.

16. Apparatus as set forth in Claim 15, including means for varying the exit angle of the moving web relative to said blade

17. Apparatus as set forth in Claim 15, including means for varying the entrance angle of the moving web relative to said blade.

18. Apparatus as set forth in Claim 15, including means for varying both the entrance angle and the exit angle of said moving web relative to said blade.

19. Apparatus as set forth in Claim 15, including means for independently controlling the force of each of said blades against said moving web.

20. Apparatus as set forth in Claim 1, including means for controlling the tension of the web.

21. Apparatus as set forth in Claim 1, including means for scraping the excess polymer from the surface of the web.

22. Apparatus as set forth in Claim 1 including means for curing the polymer composition within the porous web.

23. Apparatus as set forth in Claim 22, including means for controlling the temperature of the curing means.

24. Apparatus as set forth in Claim 22, wherein said curing means comprises a curing oven.

25. Apparatus as set forth in Claim 5, including means for controlling the temperature of said blade.

26. Apparatus as set forth in Claim 6, including means for controlling the temperature of each of said blades.

27. Apparatus as set forth in Claim 5, including means for cooling said blade to prevent premature cure of the polymer composition.

28. Apparatus as set forth in Claim 6, including means for cooling said blades to prevent premature cure of said polymer composition.

29. Apparatus as set forth in Claim 11, wherein said advancing means comprises a pair of counter-rotating nip rolls.

30. Apparatus as set forth in Claim 29, including means for controlling the pressure between said nip rolls.

31. Apparatus as set forth in Claim 29, wherein one of the nip rolls has a rubber surface of a predetermined hardness.

32. Apparatus as set forth in Claim 29, wherein both nip rolls have a rubber surface of predetermined hardness.

33. Apparatus as set forth in Claim 5, including means for damping the resonance of said blade.

34. Apparatus as set forth in Claim 6, including means for damping the resonance of said blades.

35. Apparatus as set forth in Claim 5, including means for vibrating said blade.

36. Apparatus as set forth in Claim 5, including means for vibrating said blade at a predetermined frequency.

37. Apparatus as set forth in Claim 6, including means for vibrating said blades.

38. Apparatus as set forth in Claim 6, including means for vibrating said blades individually at predetermined frequencies.

39. Apparatus as set forth in Claim 5, wherein said blade has a flat surface at the bottom thereof.

40. Apparatus as set forth in Claim 39, wherein the angle of entry of the web into said blade is greater than 0 degrees and less than 90 degrees, the web follows the bottom surface of said blade and the angle of exit of the web from said blade is greater than 0 degrees and less than 90 degrees.

41. Apparatus as set forth in Claim 1, including means for applying the polymer composition to the other side of said web, and means for shear thinning and selectively placing the polymer composition into said web from the other side of said web.

42. Apparatus as set forth in Claim 22, including means for controlling the release of longitudinal tension of said web to cause the structural members to separate prior to cure.

43. Apparatus as set forth in Claim 22 wherein said web is under substantially no tension during curing.

44. Apparatus as set forth in Claim 25 including means for holding said web under transverse tension during curing.

45. Apparatus as set forth in Claim 1 including means for distorting the web during shear thinning to facilitate entrance of the polymer composition within the web.

46. Apparatus as set forth in Claim 45 wherein said means for distorting comprises means for stretching said web transversely.

47. Apparatus for controlled placement of a polymer composition into a porous web comprising:
means for advancing a web and applying longitudinal tension;
means for applying a polymer composition of viscosity greater than 5,000 centipoise onto the surface of said moving web; and
means for shear thinning the polymer composition and controlling the depth and placement of the polymer composition within the web and for removing excess polymer composition from the surface of the moving web.

48. Apparatus according to Claim 47 wherein the means for shear thinning and controlling comprises:
a blade urged against the advancing web; and
means for controlling the force of the blade against the web

49. Apparatus according to Claim 48 wherein the apparatus further comprises one or more additional blades downstream from the first blade for working the polymer composition into the web and removing excess polymer composition from the surface of the web and from within the web.

50. Apparatus for controlled placement of a polymer composition into a porous web having a plurality of structural members comprising:
means for advancing a porous web;
means for applying a curable, shear-thinnable, polymer composition to one surface of the web;
means for shear thinning the polymer composition to substantially reduce its viscosity and for placing the reduced viscosity polymer composition into the porous web to form a thin film coating on at least some of the structural members within the web;
means for controlling the longitudinal tension of the porous web during shear thinning of said polymer composition into said web;
means for scraping the excess polymer composition from the surface of the web; and
means for curing the polymer composition within the porous web.

51. Apparatus as set forth in Claim 50 wherein longitudinal tension on the web is substantially released immediately prior to and during curing.

52. Apparatus as set forth in Claim 50, including means for controlling said shear thinning means to form an internal layer of polymer within said web positioned in a region extending through the web in a direction generally spaced from at least one major surface of said web.

53. A method of controlled placement of a curable, shear-thinnable, polymer composition into a porous web comprising:
applying longitudinal tension to the porous web;
applying a polymer composition onto a surface of the tensioned porous web; and
shear thinning the polymer composition sufficiently to reduce its viscosity and selectively placing the viscosity reduced polymer composition under pressure into the porous web.

54. The method of controlled placement according to Claim 53 further comprising:
distorting the porous web at the location of the shear thinning to facilitate entrance of the polymer composition into the web.

55. The method of controlled placement according to Claim 54 wherein the distorting comprises stretching.

56. The method of controlled placement according to Claim 55 wherein the stretching is by passage of the web under a roller rotating against the web so as to move the web past a localized area where the polymer composition is placed into the web.

57. The method of controlled placement according to Claim 53 wherein the web is moved in one direction

against a roller which rotates in the opposite direction, and a polymer is applied between the roller and the moving web.

58. The method of controlled placement according to Claim 53 further comprising passing the treated web through a pair of nip rolls under longitudinal tension and allowing the tension to be released upon exiting the nip rolls to permit the fibers of the porous web to separate from each other.

59. A method of controlled placement of a polymer composition into a porous web comprising:
shear thinning a polymer composition into a porous web to reduce the viscosity of the polymer composition so that the viscosity reduced polymer composition will be controllably placed within the porous web; and
distorting the porous web at a location of the shear thinning to facilitate entrance of the polymer composition into the web.

60. A method of controlled placement of a curable, shear-thinnable, polymer composition into a porous web comprising:
applying a polymer composition onto a surface of the porous web;
applying longitudinal tension to said porous web;
shear thinning the polymer composition to substantially reduce its viscosity and placing the shear thinned viscosity reduced polymer composition into the porous web to encapsulate at least some of the fibers of the porous web without substantially filling the interstitial spaces of the web.

61. The method of controlled placement according to Claim 60 further comprising:
distorting the porous web at a location of the shear thinning and placing to facilitate entrance of the polymer composition into the web.

62. The method of controlled placement according to Claim 61 wherein the distorting comprises stretching.

63. The method of controlled placement according to Claim 62 wherein the stretching is by passage of the web under a roller rotating against the web so as to move the web past a localized area where the polymer composition is placed into the web.

64. The method of controlled placement according to Claim 62 wherein the distorting by stretching is by passage of the web between a first roller and a second roller that is delivering the polymer composition onto the web.

65. The method of controlled placement according to Claim 64 wherein the distorting by stretching is by passage between rollers rotating in the same direction.

66. The method of controlled placement according to Claim 65 wherein the rollers rotate opposite to movement of the web past the localized area.

67. The method of controlled placement according to Claim 64 wherein the distorting by stretching is between first and second rollers at least one of which exhibits a gravure surface.

68. The method of controlled placement according to Claim 64 wherein the distorting by stretching is between first and second rollers at least one of which exhibits a smooth surface.

69. The method of controlled placement according to Claim 62 wherein the distorting by stretching is by passage of a tensioned web against a bar knife.

70. The method of controlled placement according to Claim 69 that, after the distorting by stretching under a bar knife, further comprises:
scraping the porous web with a scraper so as to scrape excess polymer composition off the surface of the web.

71. The method of controlled placement according to Claim 70 wherein the scraping is under pressure against a tensioned web so that further pressure is exerted against the polymer composition so as to again reduce its viscosity and again place it, under this further pressure, into the porous web.

72. The method of controlled placement according to Claim 71 wherein the pressured scraping simultaneously occurs at a plurality of locations on the tensioned web as it moves under tension past a like plurality of scrapers.

73. The method of controlled placement according to Claim 59 wherein the shear thinning and placing comprises:
first pressuring in a pressured application stage that delivers the polymer composition onto and into the porous web under pressure;
second pressuring in a pressured excess-removal stage that further pressures the polymer composition that is in and upon the porous web resulting from the first pressuring further into the web while removing excess polymer composition that is upon and in the web.

74. The method of controlled placement according to Claim 73 wherein the first pressuring comprises:
rolling the polymer composition onto and into the porous web under pressure;
and wherein the second pressuring comprises:
scraping the porous web with a scraper so as to exert pressure thereagainst while removing excess polymer composition by action of scraping.

75. The method according to Claim 74, wherein the rolling is between two rollers rotating in the same direction thereby stretching the web between the rollers simultaneously so that the polymer composition is rolled onto and into the porous web under pressure.

76. A method of controlled placement according to Claim 53 wherein the porous web has a plurality of structural elements with interstitial spaces therebetween and the polymer composition is selectively placed to encapsulate at least some of the structural elements of the web leaving some of the interstitial spaces open.

77. A method of controlled placement according to Claim 53 wherein the polymer composition is selectively placed in an internal layer within said web positioned in a region extending through the web in a direction generally spaced from at least one major surface of said web.

78. A method of controlled placement according to Claim 76 wherein the polymer composition is also selectively placed in an internal layer within said web positioned in a region extending through the web in a direction generally parallel to and spaced from at least one major surface of said web.

79. A method of controlled placement in accordance with Claim 60 wherein the shear thinning and placing is controlled to also selectively place the polymer composition in an internal layer within said web positioned in a region extending through the web in a direction generally spaced from at least one major surface of said web.

80. A method of controlled placement in accordance with Claim 53 wherein said web has a plurality of structural elements with interstitial spaces therebetween and said selective placing is encapsulation of at least some of the structural elements of said web, leaving at least some of the interstitial spaces open.

81. A method of controlled placement according to Claim 53 wherein said porous web has a plurality of structural elements with interstitial spaces therebetween and the polymer composition is selectively placed as an internal layer within said web positioned in a region extending through the web in a direction generally spaced from at least one major surface of said web.

82. A method of controlled placement according to Claim 81 wherein the polymer composition is also selectively placed to encapsulate at least some of the structural elements of the web.

83. A method according to Claim 53 wherein said porous web has a number of open cells and said polymer composition is selectively placed to line at least some of the individual cell walls leaving at least some of the cells open.

84. A method according to Claim 83 wherein the polymer composition is also selectively placed in an internal layer within said web positioned in a region extending through the web in a direction generally spaced from at least one major surface of said web.

85. A method of controlled placement according to Claim 53 wherein said shear thinning and placing includes urging one or more blades against the tensioned web and polymer composition.

86. A method of controlled placement according to Claim 85 including controlling the force of each blade against said moving web.

87. A method of controlled placement according to Claim 85 further comprising controlling the tension of the web as it passes each blade.

88. A method of controlled placement according to Claim 85 comprising controlling the temperature of each blade.

89. A method of controlled placement according to Claim 85 comprising controlling the entrance angle of the web and the exit angle of the web from each blade.

90. A method of controlled placement according to Claim 85 comprising controlling the resonance of each blade.

91. A method of controlled placement according to Claim 85 comprising the longitudinal tension of said moving web.

92. A method of controlled placement according to Claim 85 further comprising the step of applying a transverse force to said web after shear thinning and placing.

93. A method of controlling the placement of a polymer composition into a porous substrate having a matrix

of open cells therein comprising the steps of:

applying tension longitudinally to said substrate;

applying a curable polymer composition having a viscosity sufficient to line the walls of said cells to at least one surface of said substrate;

moving against said surface of the tensioned substrate at least one of a uniformly applied compressive force and a uniformly applied localized shear force to selectively distribute said composition within said substrate, at least partially individually lining cell walls of at least some of said cells with said composition, and leaving most of said cells open.

94. The method of Claim 93 wherein said polymer composition has a viscosity greater than about 5,000 and less than about 2,000,000 centipoise.

95. The method of Claim 94 wherein the substrate is subjected to conditions sufficient to cure the polymer composition in said substrate.

96. The method of Claim 95 wherein said curing is accomplished by heat.

97. The method of Claim 95 wherein said curing is accomplished by radiation.

98. A method for making a fluorochemical and silicone resin treated substrate having breathability, water resistance and rewashability comprising the successive steps of:

(a) impregnating a porous substrate having generally open cells therein, with a fluorochemical;

(b) applying a curable silicone polymer composition and concurrently applying a transversely exerted localized compressive force against one surface of the substrate;

(c) moving relative to said surface of the substrate a substantially rigid shearing means which exerts transversely applied localized shear forces against said surface and which wipes away exposed portions of silicone polymer composition on said surface, thereby forming an internal layer of silicone polymer composition; and

(d) curing the silicone polymer composition in said substrate.

99. The method of Claim 98 wherein said fluorochemical impregnated substrate is both longitudinally and laterally tensioned.

100. The method of Claim 98 wherein said porous substrate is a leather.

101. The method of Claim 98 wherein said porous substrate is a porous paper.

102. The method of Claim 98 wherein said porous substrate is an open celled plastic.

103. The method of Claim 98 wherein said porous substrate is an open celled sheet structure.

104. The method of Claim 98 wherein said substrate is a synthetic leather.

105. The method of Claim 98 wherein said substrate comprises a layer of an open celled, porous, flexible material and a layer of a non-porous flexible material.

106. The method of Claim 98 wherein said fluorochemical impregnating is carried out by the steps comprising:

(a) substantially completely saturating said substrate with a dispersion of a fluorochemical containing composition in a carrier liquid;

(b) compressing the saturated substrate to remove therefrom excess portions of said dispersion; and

(c) heating said substrate to evaporate said carrier liquid therefrom.

107. A method of controlling the placement of a polymer composition into a porous web comprising the steps of:

(a) tensioning a flexible, porous web comprised of fibers having interstices therebetween, said web having generally opposed surfaces,

(b) applying a curable polymer composition having a viscosity greater than about 1,000 centipoise to at least one surface of said web and then

(c) moving over and against said surface of the tensioned web at least one of a uniformly applied localized shear force or a uniformly applied localized compressive force to:

(1) distribute said composition generally uniformly within said web,

(2) at least partially individually encapsulate at least some of said fibers with said composition, and

(3) leave at least some of said interstices open.

108. The method of Claim 107 wherein the web is subjected to conditions sufficient to cure said polymer composition in said web.

109. The method of Claim 108 wherein said curing is accomplished by heat.

110. The method of Claim 109 wherein said curing is accomplished by radiation.

111. A method for making a fluorochemical and silicone resin treated web having breathability, water resistance and rewashability comprising the successive steps of:

(a) substantially uniformly impregnating the fibers of a porous web with a fluorochemical;

(b) tensioning said fluorochemical impregnated web while sequentially:

(1) first applying a curable silicone polymer composition to a surface of said web while applying a transversely exerted localized compressive force against said surface, and

(2) moving a substantially rigid, shearing means which transversely exerts an applied, localized shear force against said surface of the web to remove exposed portions of said silicone polymer composition from said surface, thereby individually encapsulating at least some of said fibers with said silicone polymer composition; and

(c) curing the silicone polymer composition in the web.

112. The method of Claim 111 wherein said porous web is a woven fabric.

113. The method of Claim 111 wherein said porous web is a non-woven fabric.

114. The method of Claim 111 wherein said fibers are comprised of a synthetic polymer.

115. The method of Claim 114 wherein said synthetic polymer is selected from the group consisting of polyamides, polyolefins, polyesters, regenerated cellulose and cellulose acetate.

116. The method of Claim 111 wherein said fibers are comprised of natural fibers.

117. The method of Claim 116 wherein said natural fibers are selected from the group consisting of cotton, linen, wool and silk.

118. The method of Claim 111 wherein said fibers are comprised of a mixture of natural fibers and synthetic fibers.

119. The method of Claim 118 wherein said fibers are comprised of a blend of cotton fibers and polyester fibers.

120. The method of Claim 111 wherein said web is a laminate of a woven fabric and a porous, flexible, non-woven substrate.

121. The method of Claim 120 wherein said substrate comprises a non-woven fabric.

122. The method of Claim 111 wherein said fluorochemical impregnating is carried out by the steps comprising:

(a) substantially completely saturating said web with a dispersion of a fluorochemical composition in a carrier liquid;

(b) compressing the saturated web to remove therefrom excess portions of said dispersion; and

(c) heating said web to evaporate said carrier liquid therefrom.

123. The method of Claim 122 wherein the fluorochemical impregnated web has a weight increase in the range of about 0.01 to about 5 weight percent of the weight of the untreated web.

124. The method of Claim 123 wherein the silicone polymer composition impregnated web has a weight increase in the range of about 5 to about 200 weight percent compared to the weight of the untreated web.

125. Apparatus as set forth in Claim 2 wherein said polymer composition includes an additive and at least some of said additive in selectively placed on the surface of the encapsulated structural elements.

126. Apparatus is set forth in Claim 3 wherein said polymer composition includes an additive and at least some of said additive is placed on one or both surfaces of the internal layer.

127. Apparatus as set forth in Claim 4 wherein said polymer composition includes an additive and at least some of said additive is placed on the surface of the encapsulated structural elements and at least some of said additive is placed on one or both surfaces of the internal layer.

128. Apparatus as set forth in Claim 1 wherein said polymer composition includes an additive and at least some of said additive is selectively placed on one or both surfaces of said web.

129. A method of controlled placement as set forth in Claim 76 wherein the polymer composition includes an additive and at least some of said additive is selectively placed on the surface of the encapsulated structural elements.

130. A method of controlled placement is set forth in Claim 77 wherein the polymer composition includes an additive and at least some of said additive is selectively placed on one or both surfaces of the internal layer.

131. A method of controlled placement as set forth in Claim 78 wherein the polymer composition includes an additive and at least some of said additive is placed on the surface of the encapsulated structural

elements and at least some of said additive is placed on one or both surfaces of the internal layer.

132. A method of controlled placement as set forth in Claim 53 wherein said polymer composition includes an additive and at least some of said additive is selectively placed on one or both surfaces of said web.

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